

A further study of the spider genus *Notiocoelotes* (Araneae, Agelenidae) from Hainan Island, China

Xiaoqing Zhang¹, Zhe Zhao², Guo Zheng¹, Shuqiang Li²

1 College of Life Sciences, Shenyang Normal University, Shenyang, Liaoning 110034, China **2** Institute of Zoology, Chinese Academy of Sciences, Beijing 100101, China

Corresponding authors: Guo Zheng (zhengguo@synu.edu.cn); Shuqiang Li (lisq@ioz.ac.cn)

Academic editor: Y. Marusik | Received 5 January 2016 | Accepted 4 June 2016 | Published 29 June 2016

<http://zoobank.org/ACC60023-AEE3-4FE9-9622-C91D58AED849>

Citation: Zhang X, Zhao Z, Zheng G, Li S (2016) A further study of the spider genus *Notiocoelotes* (Araneae, Agelenidae) from Hainan Island, China. ZooKeys 601: 75–87. doi: 10.3897/zookeys.601.7698

Abstract

Two new *Notiocoelotes* species, *N. maoganensis* **sp. n.** (♂♀) and *N. qiongzhongensis* **sp. n.** (♂♀) are described from Hainan Island, China. In addition, the female of *N. membranaceus* Liu & Li, 2010 is described for the first time. DNA barcodes of three species treated in this paper were obtained for future use.

Keywords

Taxonomy, Coelotinae, description, diagnosis, Southeast Asia

Introduction

The spider genus *Notiocoelotes* was established by Wang et al. (2008) for one coelotine species from Hainan Island, China: *Coelotes palinitropus* Zhu & Wang, 1994. Additionally, Wang et al. (2008) described three new species: *N. laosensis* Wang, Xu & Li, 2008, *N. lingulatus* Wang, Xu & Li, 2008, *N. vietnamensis* Wang, Xu & Li, 2008, and transferred *Iwogumoa sparus* Dankittipakul, Chami-Kranon & Wang, 2005 to *Notiocoelotes*. Currently, eleven species of *Notiocoelotes* are known (World Spider Catalog 2016), six of which are restricted to Hainan, China. This paper provides the descriptions of two new *Notiocoelotes* species and a redescription of *N. membranaceus*.

Material and methods

Specimens were examined with a LEICA M205C stereomicroscope. Images were captured with an Olympus C7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus SZX12 dissecting microscope. Epigynes and male palps were examined after dissection from the spiders' bodies.

All measurements were obtained using a LEICA M205C stereomicroscope and are given in millimeters. Leg measurements are shown as: Total length (femur, patella + tibia, metatarsus, tarsus). Only structures (palp and legs) of the left body side were described and measured. The terminology used in the text and the figure legends follows Wang (2002). Abbreviations used in this paper and in the figure legends: A = epigynal atrium; ALE = anterior lateral eye; AME = anterior median eye; AME-ALE = distance between AME and ALE; AME-AME = distance between AME and AME; ALE-PLE = distance between ALE and PLE; CD = copulatory duct; CF = cymbial furrow; CL = conductor lamella; CO = conductor; E = embolus; EB = embolic base; ES = epigynal scape; FD = fertilization duct; LTA = lateral tibial apophysis; MA = median apophysis; PLE = posterior lateral eye; PME = posterior median eye; PME-PLE = distance between PME and PLE; PME-PME = distance between PME and PME; R = receptacle; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum.

DNA barcodes were obtained for future use. A partial fragment of the mitochondrial gene cytochrome oxidase subunit I (COI) was amplified and sequenced for *N. maoganensis* sp. n., *N. membranaceus* and *N. qiongzhongensis* sp. n. using primers LCO1490-oono (5'-CWACAAAYCATARRGATATTGG-3') (Folmer et al. 1994; Miller et al. 2010) and HCO2198-zz (5'-TAAACTTCCAGGTGACCAAAAAATCA-3') (Folmer et al. 1994; Chen et al. 2015). For additional information on extraction, amplification, and sequencing procedures, see Zhao et al. 2013. All sequences were deposited in GenBank and the accession numbers are provided in Table 1.

All specimens (including molecular vouchers) are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing (IZCAS).

Table 1. Voucher specimen information.

Species	GenBank accession number	Sequence length	Collection localities
<i>Notiocoelotes maoganensis</i> sp. n.	KU886075	657 bp	Baoting County, Hainan, China
<i>Notiocoelotes membranaceus</i>	KU886076	666 bp	Qiongzhong County, Hainan, China
<i>Notiocoelotes qiongzhongensis</i> sp. n.	KU886074	666 bp	Qiongzhong County, Hainan, China

Taxonomy

Family Agelenidae C.L. Koch, 1837

Subfamily Coelotinae F.O.P.-Cambridge, 1893

Genus *Notiocoelotes* Wang, Xu & Li, 2008

Notiocoelotes Wang et al, 2008: 11. Type species *Coelotes palinitropus* Zhu & Wang, 1994, from Hainan Island, China.

Diagnosis. The chelicerae of all *Notiocoelotes* have 3 promarginal and 2 retromarginal teeth, while other coelotines usually have 3 or 4 retromarginal teeth. Females of this genus can be separated from other coelotines by the absence of epigynal teeth and the presence of a tongue-shaped epigynal scape (Fig. 2A–B); other coelotines usually have long and broad epigynal teeth. Males can be distinguished from other coelotines by the absence of a patellar apophysis, the presence of a large and strongly bifurcated lateral tibial apophysis and the reduced or invisible median apophysis (Fig. 1); other coelotines usually have a thick patellar apophysis and the special shaped median apophysis.

Composition. Thirteen *Notiocoelotes* species are currently known: *N. laosensis* (♀) from Laos; *N. parvitriangulus* Liu, Li & Pham, 2010 (♀), *N. pseudovietnamensis* Liu, Li & Pham, 2010 (♂♀) and *N. vietnamensis* (♂♀) from Vietnam; *N. sparus* (♂) from Thailand; *N. lingulatus* (♀), *N. membranaceus* (♂), *N. orbiculatus* Liu & Li, 2010 (♂♀), *N. palinitropus* (♂♀), *N. pseudolingulatus* Liu & Li, 2010 (♂♀), and *N. spirellus* Liu & Li, 2010 (♂♀) from Hainan, China (World Spider Catalog 2016), and two new species described in this paper: *N. maoganensis* sp. n. (♂♀), *N. qiongzhongensis* sp. n. (♂♀) from Hainan.

***Notiocoelotes maoganensis* Zhao & Li, sp. n.**

<http://zoobank.org/77DC1620-6C90-4167-BA47-CE30A39BF135>

Figs 1–2, 7

Type material. Holotype ♂: China: Hainan: Baoting County: Maogan Village, Xi-ananshilin Cave, N18°35'52", E109°25'37", 616 m, 26.VI.2014, F. Li & X. Wang.

Paratype: 1♀, same data as holotype.

Etymology. The specific name refers to the type locality; adjective.

Diagnosis. The male of *N. maoganensis* sp. n. can be easily distinguished from all other *Notiocoelotes* species, except *N. palinitropus*, by having a semi-circular conductor. From *N. palinitropus*, the male of the new species can be distinguished by the short cymbial furrow about 1/3 of cymbial length (while *N. palinitropus* male has a long cymbial furrow, about 0.5 times as long as cymbial length) (cf. Fig. 1A–C; Zhu and Wang 1994: figs 19–21). The female of *N. maoganensis* sp. n. can be easily distinguished from all the other *Notiocoelotes* species, except *N. palinitropus*, by the

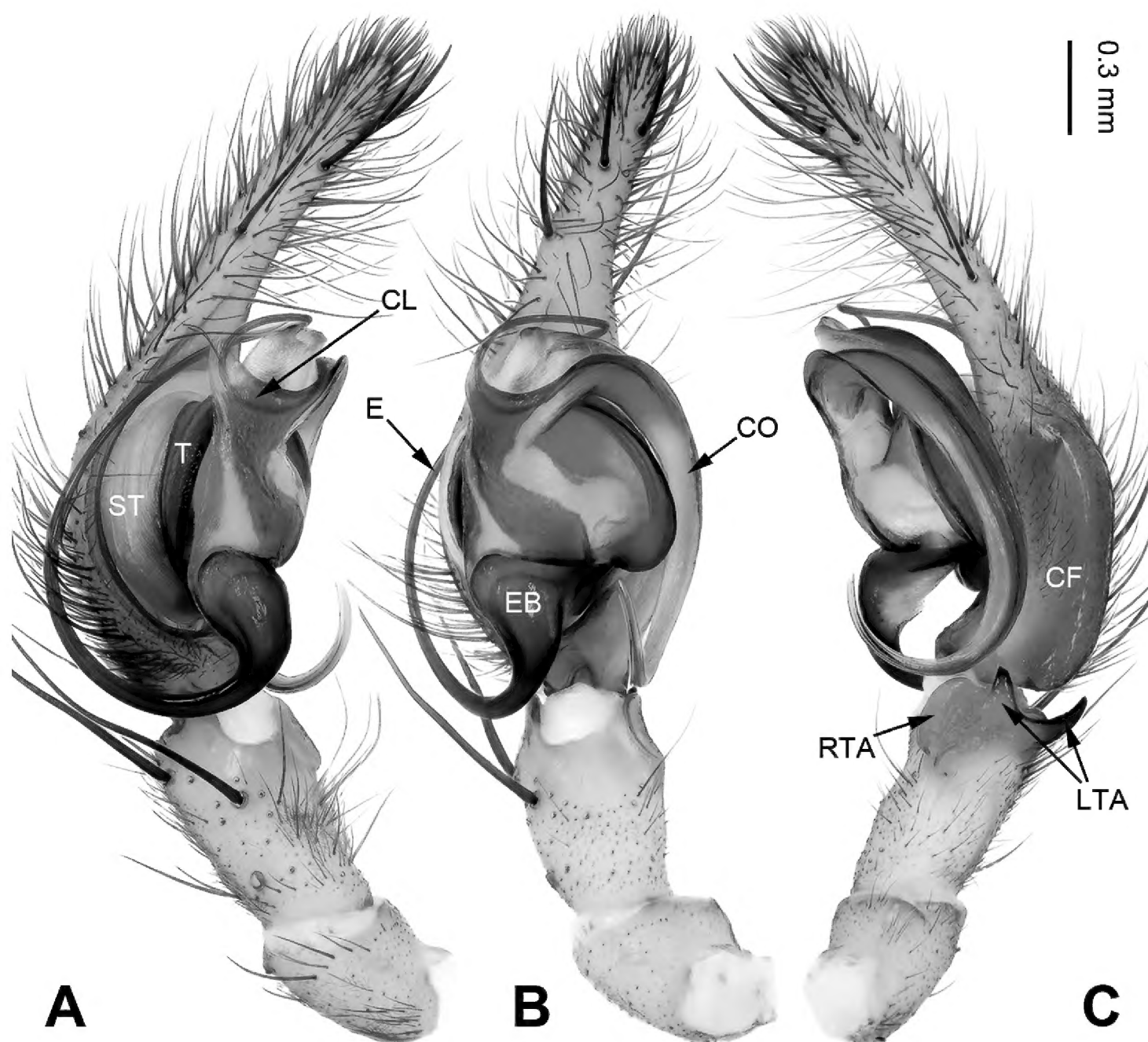


Figure 1. Left palp of *Notiocoelotes maoganensis* sp. n., holotype. **A** Prolateral view **B** Ventral view **C** Retrolateral view. CF = cymbial furrow; CL = conductor lamella; CO = conductor; E = embolus; EB = embolic base; LTA = lateral tibial apophysis; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum. Scale bar: Equal for **A**, **B** and **C**.

almost rectangular atrium. From *N. palinitropus*, the female of the new species can be distinguished by a broad atrium, about two times as long as wide (while *N. palinitropus* female has a narrow atrium, about three times as long as wide) (cf. Fig. 2A–B; Liu and Li 2010: fig. 9B).

Description. Male (holotype): Total length 8.60. Carapace 4.75 long, 3.50 wide. Abdomen 3.85 long, 2.75 wide. Eye sizes and interdistances: AME 0.20, ALE 0.23, PME 0.25, PLE 0.25; AME-AME 0.08, AME-ALE 0.02, PME-PME 0.08, PME-PLE 0.10. Leg measurements: I: 21.15 (5.75, 6.00, 5.50, 3.90); II: 18.00 (5.50, 5.25, 4.50, 2.75); III: 17.00 (5.00, 5.00, 4.75, 2.25); IV: 22.35 (6.25, 6.70, 6.50, 2.90). Carapace yellowish, the radial grooves indistinct, with the nearly lip-shaped dark pattern, sternum yellowish, about almond-shaped. Abdomen brownish, with yellow and transversal spots, nearly oval-shaped. Legs yellowish, with black annulations. Palp: tibia long,

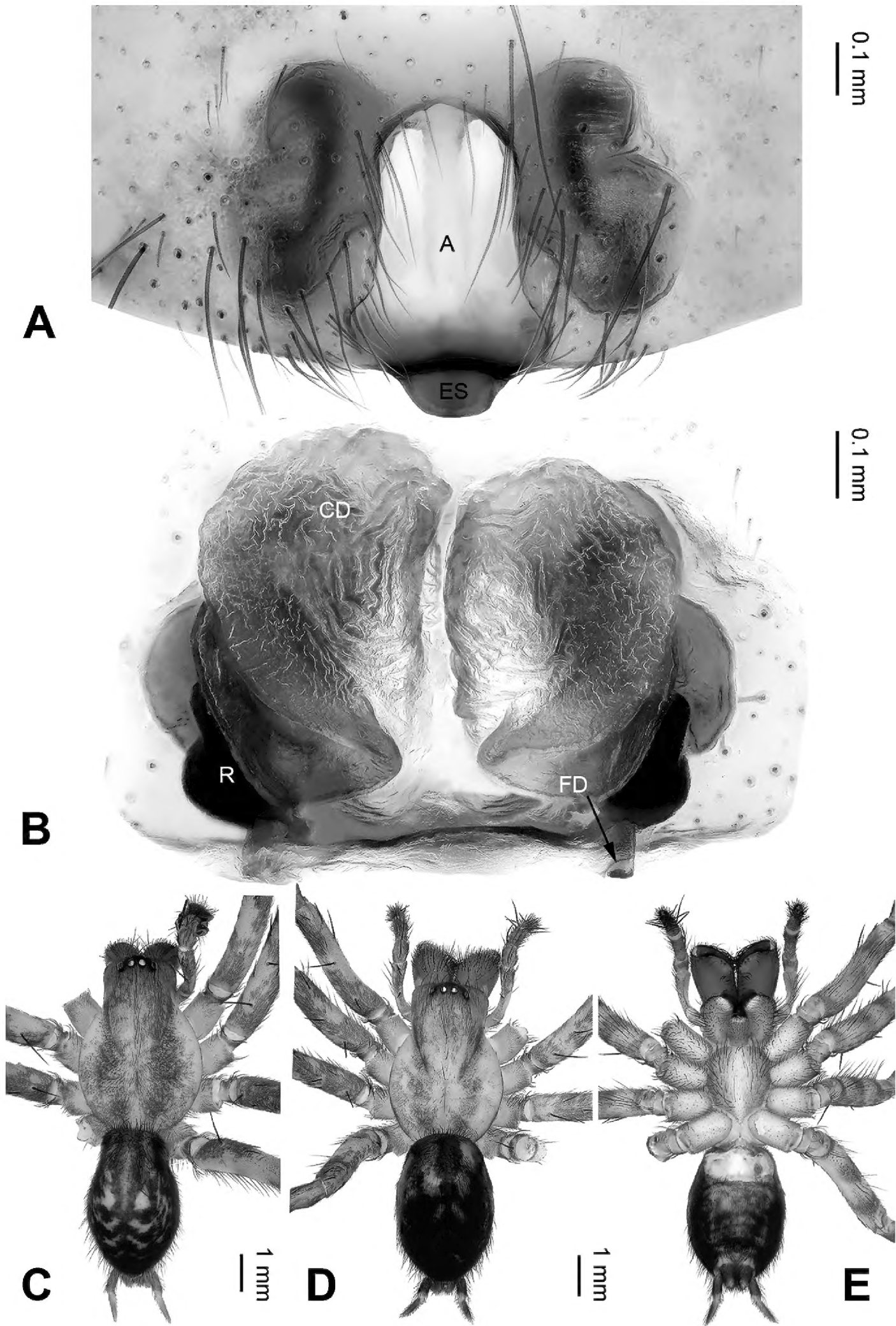


Figure 2. Epigyne and habitus of *Notiocoelotes maoganensis* sp. n. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for **D** and **E**.

about 1/3 of cymbial length; RTA small, 1/3 of tibial length; LTA divided into two parts, most crescent-shaped and about 1/2 length of RTA; conductor long, with one loop; embolus beginning at 6:30 o'clock position, with the triangular base, about 1/3 width of tibia (Fig. 1A–C).

Female (paratype): Total length 8.75. Carapace 4.25 long, 3.50 wide. Abdomen 4.50 long, 3.00 wide. Eye sizes and interdistances: AME 0.20, ALE 0.28, PME 0.25, PLE 0.25; AME-AME 0.05, AME-ALE 0.01, PME-PME 0.08, PME-PLE 0.10. Leg measurements: I: 16.50 (4.75, 5.00, 4.00, 2.75); II: 14.25 (4.25, 4.50, 3.50, 2.00); III: 13.10 (4.00, 4.10, 3.25, 1.75); IV: 17.65 (5.15, 5.75, 4.50, 2.25). Carapace beige, with grey lateral margins; sternum nearly almond-shaped, light brown, with wide yellow median band. Abdomen grey-brown, nearly oval-shaped, with beige herringbone pattern. Legs yellowish, with black annulations. Epigyne: atrium elongated, with distinct septum, about two times as long as wide, posterior broaden; copulatory ducts covering anterior parts of receptacles, about 1.2 times as long as wide; receptacles narrow, about 2.5 times as long as wide; copulatory openings distinct (Fig. 2A–B).

Distribution. Known only from the type locality (Fig. 7).

Notiocoelotes membranaceus Liu & Li, 2010

Figs 3–4, 7

Notiocoelotes membranaceus Liu & Li, 2010: 33, figs 2A–C, 3A–D (♂).

Type material. Holotype ♂: China: Hainan: Qiongzong County: Mt. Limushan Nature Reserve, 13 August 2007, S. Li, C. Wang, L. Lin & J. Xu leg.

Other material examined. 3♀3♂: China: Hainan: Qiongzong County: Mt. Limushan Nature Reserve, Binlang Lake, N19°11'59", E109°43'45", 576 m, 4.XII.2015, X. Zhang & Z. Chen; 2♀, China: Hainan: Qiongzong County: Mt. Limushan, N19°10'52", E109°45'19", 962 m, 2.V.2011, Y. Zhou.

Diagnosis. The female of *N. membranaceus* can be distinguished from all the other *Notiocoelotes*, except *N. orbiculatus*, by the almost oval atrium. From *N. orbiculatus*, the new species can be distinguished by the egg-shaped receptacles (while *N. orbiculatus* has globular and widely separated receptacles) (cf. Fig. 4A–B; Liu and Li 2010: fig. 7B).

Description. Male: described in detail by Liu and Li (2010: fig. 2A–C) (Fig. 3A–C).

Female: Total length 4.75. Carapace 2.50 long, 1.75 wide. Abdomen 2.25 long, 1.75 wide. Eye sizes and interdistances: AME 0.08, ALE 0.15, PME 0.15, PLE 0.15; AME-AME 0.03, AME-ALE 0.01, PME-PME 0.05, PME-PLE 0.06. Leg measurements: I: 7.00 (2.05, 2.25, 1.60, 1.10); II: 6.10 (1.85, 1.90, 1.55, 0.80); III: 5.50 (1.70, 1.75, 1.30, 0.75); IV: 7.50 (2.25, 2.30, 2.00, 0.95). Carapace yellowish, with black dark lateral margins; sternum yellow, margins darker than median part. Abdomen yellowish-brown, with black and nearly chevrons-shaped stripes, nearly pineapple-shaped. Legs yellowish, with black annulations. Epigyne: atrium semicircular, about 1.5 times as long as wide, with distinct septum;

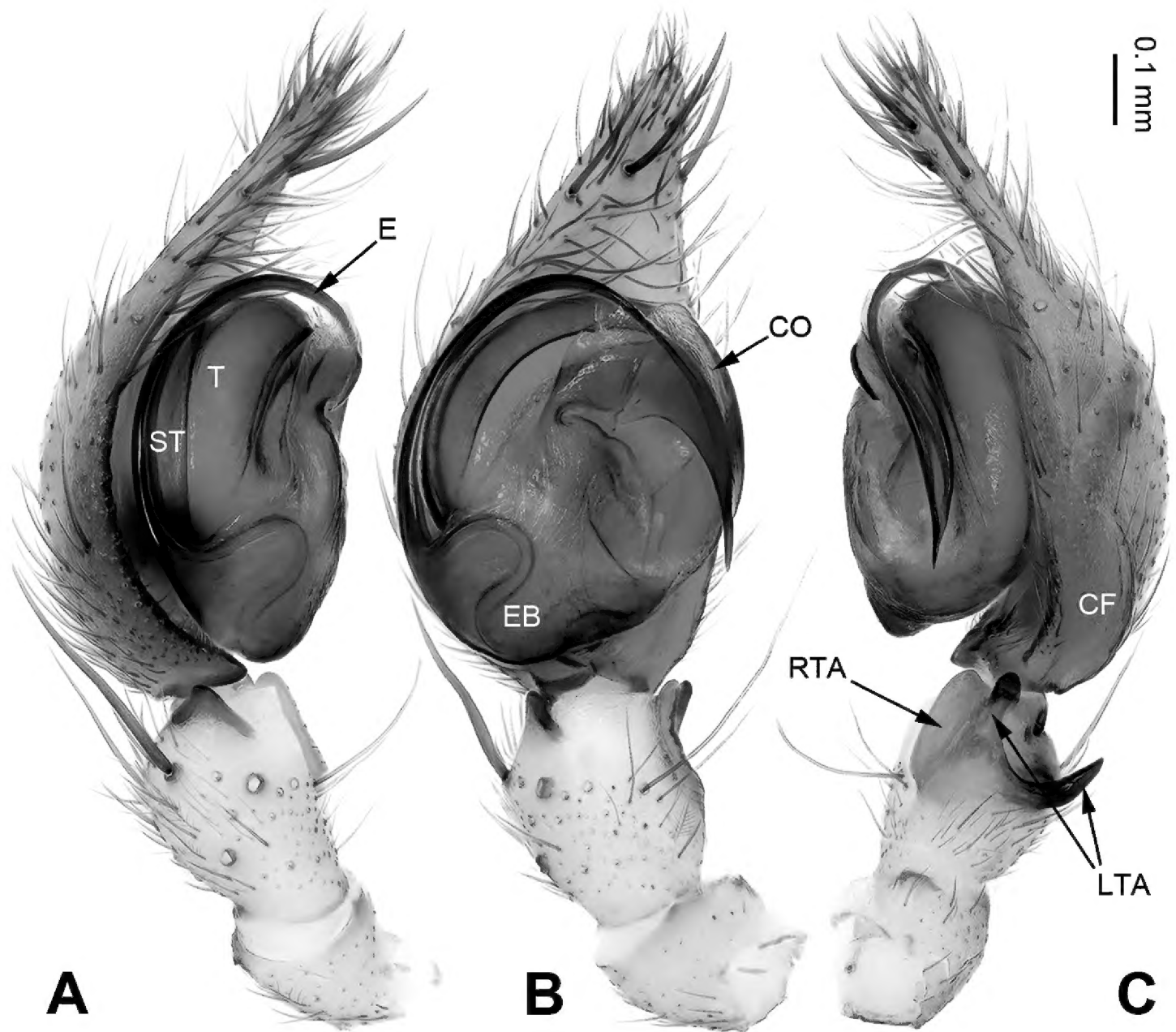


Figure 3. Left palp of *Notiocoelotes membranaceus*, specimen from Hainan. **A** Prolateral view **B** Ventral view **C** Retrolateral view. CF = cymbial furrow; CO = conductor; E = embolus; EB = embolic base; LTA = lateral tibial apophysis; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum. Scale bar: Equal for **A**, **B** and **C**.

epigynal scape wide; copulatory ducts long, about 0.9 times as long as receptacles, well sclerotized; receptacles long, about 1.5 times as long as wide; copulatory openings distinct (Fig. 4A–B).

Distribution. China (Hainan) (Fig. 7).

Remarks. Female of this species is described for the first time. Although the shape of the palp and epigyne of *N. membranaceus* are a little different from those of the type species of the genus *Notiocoelotes*, the taxonomic placement of this species is supported by the following two features. First, according to the molecular data (our COI sequences, unpublished), *N. membranaceus* is closely related to *N. orbiculatus* and *N. qiongzhongensis* sp. n. Second, the male of *N. membranaceus* has a strongly bifurcated lateral tibial apophysis, characteristic for the males of all *Notiocoelotes* species; the female of *N. membranaceus* has a tongue-shaped epigynal scape, characteristic for the females of all *Notiocoelotes* species.

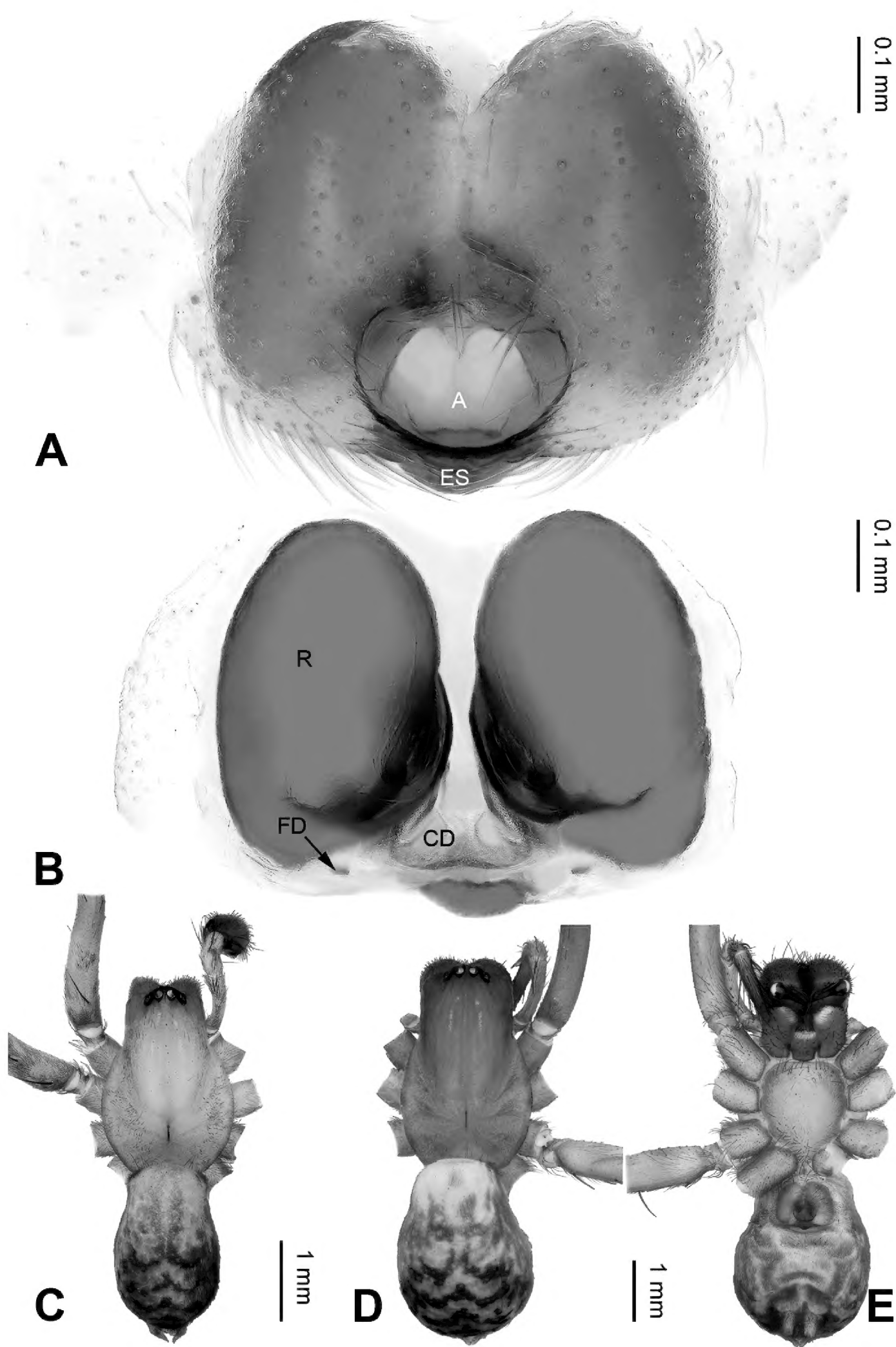


Figure 4. Epigyne and habitus of *Notiocoelotes membranaceus*, specimens from Hainan. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for **D** and **E**.

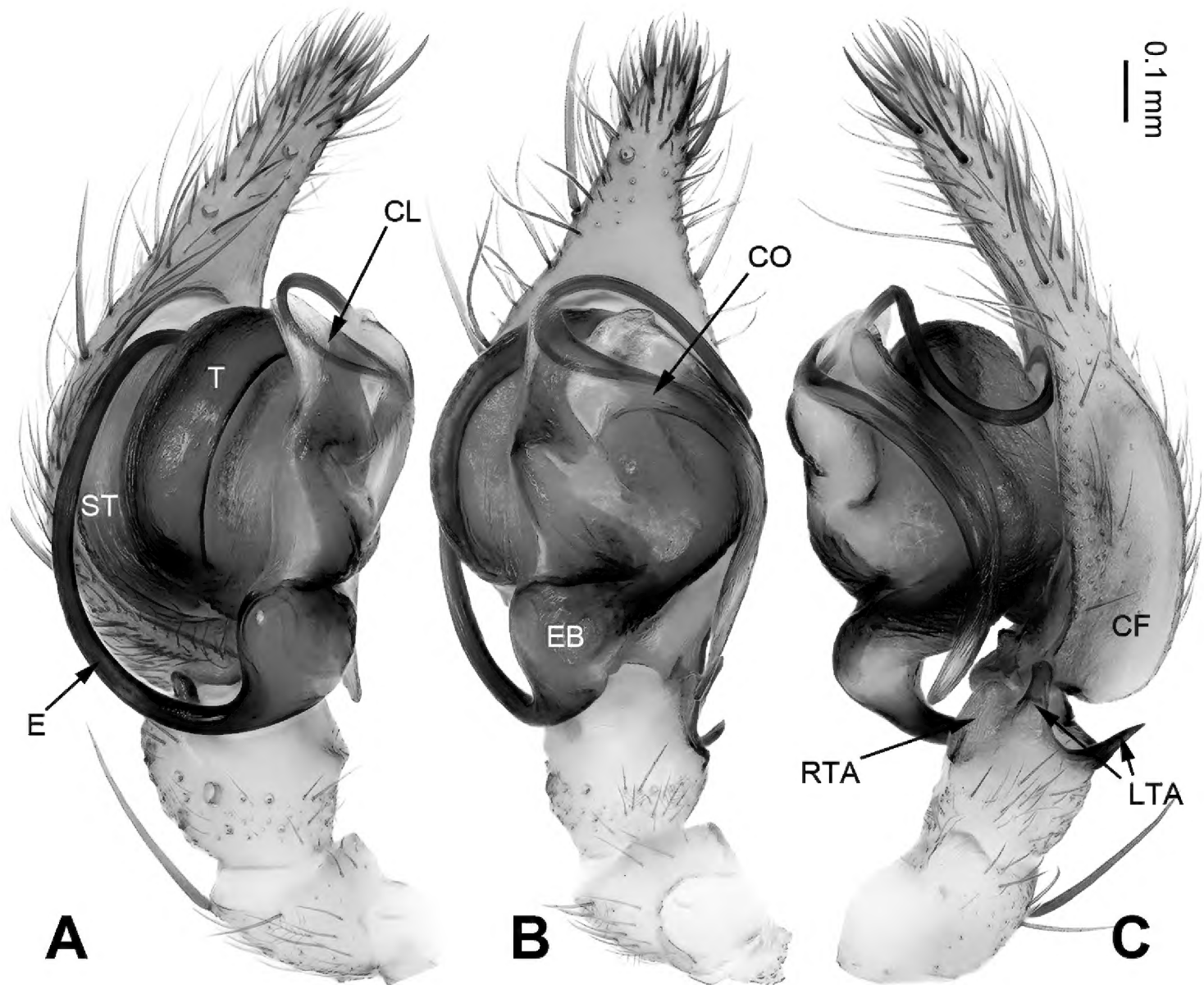


Figure 5. Left palp of *Notiocoelotes qionghongensis* sp. n., holotype. **A** Prolateral view **B** Ventral view **C** Retrolateral view. CF = cymbial furrow; CL = conductor lamella; CO = conductor; E = embolus; EB = embolic base; LTA = lateral tibial apophysis; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum. Scale bar: Equal for **A**, **B** and **C**.

***Notiocoelotes qionghongensis* Zhao & Li, sp. n.**

<http://zoobank.org/1AE669ED-AA8C-4EF0-A883-D0E0984D1F55>

Figs 5–6, 7

Type material. Holotype ♂: China: Hainan: Qionghong County: Mt. Limushan, Pine forest, N19°10'53", E109°45'20", 537 m, 2.XII.2015, X. Zhang & Z. Chen.

Paratypes: 2♀3♂, same data as holotype; 1♀, same area, N19°10'55", E109°45'17", 637 m, 3.V.2011, Y. Zhou.

Etymology. The specific name refers to the type locality; adjective.

Diagnosis. The male of *N. qionghongensis*, sp. n. can be distinguished from all of the other *Notiocoelotes* species, except *N. pseudolingulatus* and *N. sparus*, by having posteriorly extended conductor and cymbial furrow almost half of cymbial length. From the latter two species, it can be distinguished by the semicircular conductor apex (while *N. pseudolingulatus* has a blunt apex, and *N. sparus* has an acute apex) (cf. Fig. 5A–C; Liu and Li 2010: figs 10–11; Dankittipakul et al. 2005: figs 1–3). The female of *N.*

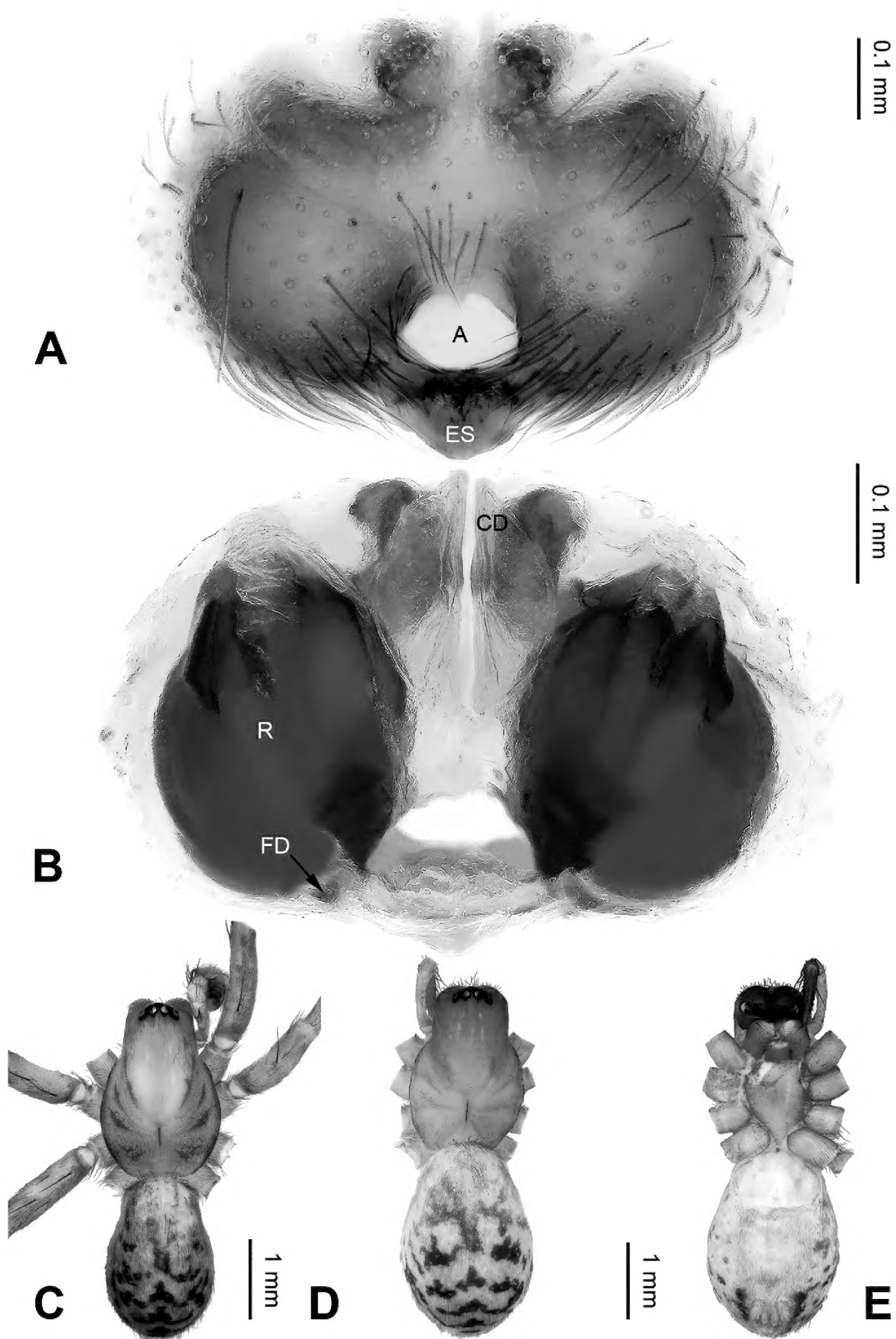


Figure 6. Epigyne and habitus of *Notiocoelotes qiongzhongensis* sp. n. **A** Epigyne, ventral view **B** Vulva, dorsal view **C** Male habitus, dorsal view **D** Female habitus, dorsal view **E** Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for **D** and **E**.

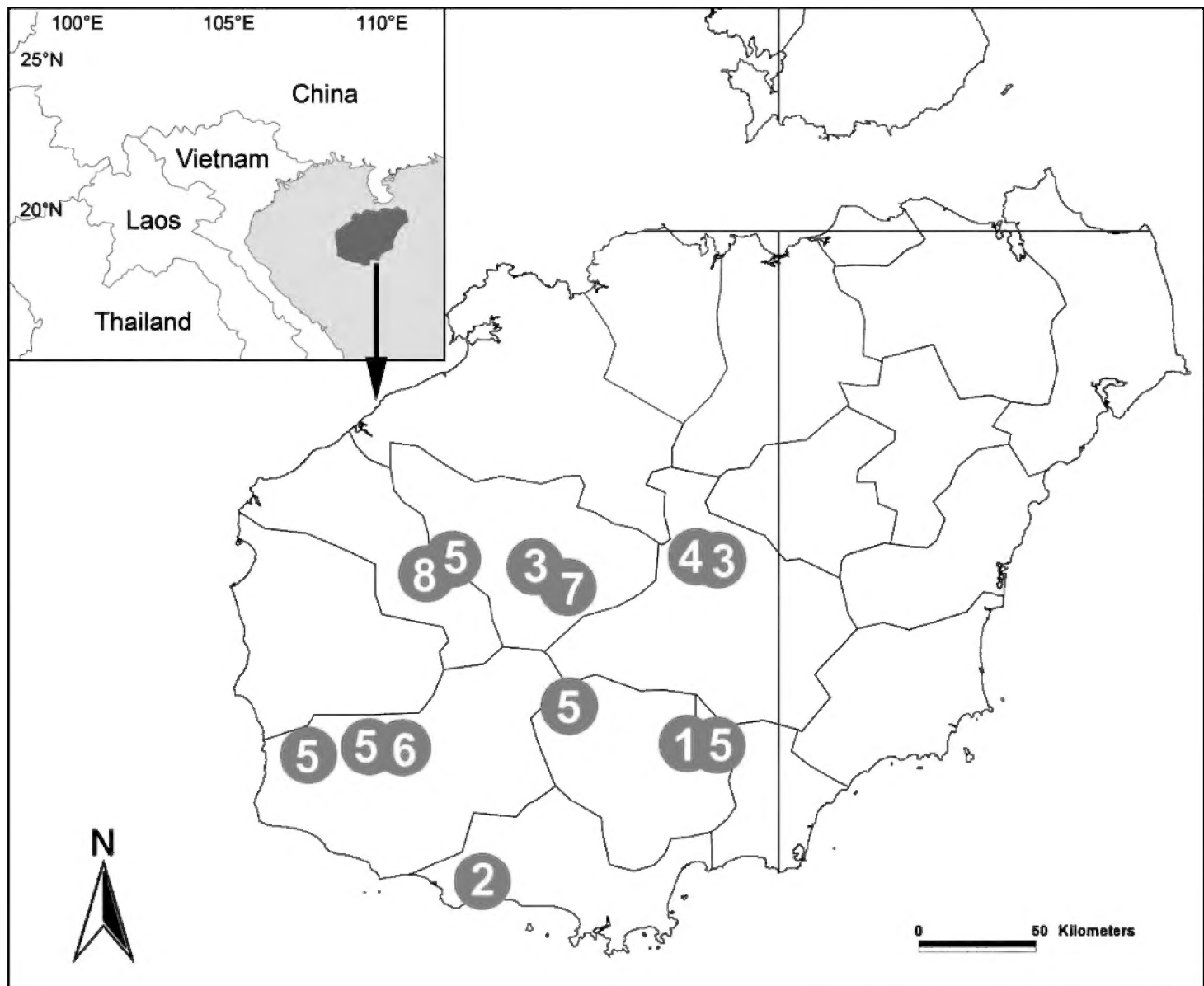


Figure 7. Localities of *Notiocoelotes* species from Hainan. **1** *N. lingulatus* **2** *N. maoganensis* sp. n. **3** *N. membranaceus* **4** *N. orbiculatus* **5** *N. palinitropus* **6** *N. pseudolingulatus* **7** *N. qiongzhongensis* sp. n. **8** *N. spirellus*.

qiongzhongensis, sp. n. can be distinguished from all *Notiocoelotes*, except *N. orbiculatus* and *N. parvitriangulus*, by the rounded receptacles. It can be distinguished from *N. orbiculatus* by the head of receptacles situated on anterior part of receptacles (while the head of receptacles is situated on posterior part of receptacles in *N. orbiculatus*); and it can be distinguished from *N. parvitriangulus* by the nearly square-shaped atrium (while *N. parvitriangulus* has a triangular atrium) (cf. Fig. 6A–B; Liu and Li 2010: fig. 7B; Liu et al. 2010: fig. 78A).

Description. Male (holotype): Total length 4.20. Carapace 2.15 long, 1.60 wide. Abdomen 2.05 long, 1.50 wide. Eye sizes and interdistances: AME 0.05, ALE 0.12, PME 0.15, PLE 0.12; AME-AME 0.04, AME-ALE 0.01, PME-PME 0.04, PME-PLE 0.03. Leg measurements: I: 6.65 (1.95, 2.15, 1.55, 1.00); II: 5.60 (1.75, 1.80, 1.25, 0.80); III: 5.05 (1.50, 1.55, 1.25, 0.75); IV: 7.05 (2.00, 2.25, 1.90, 0.90). Carapace yellowish, with the black and broad radial grooves, with black lateral margins. Abdomen grey, with black spots, nearly eggplant-shaped. Legs yellowish, with black annulations. Palp: tibia short, about 1/4 of cymbial length; RTA about half of tibial length;

LTA divided into two parts, almost hook-shaped and subequal the length of RTA; conductor nearly arc-shaped, about 1.5 times as long as tegulum, with two loops; embolus beginning at 7:00 o'clock position, with a nearly chestnut-shaped base, about 1/2 width of tibia (Fig. 5A–C).

Female (one of paratypes): Total length 4.50. Carapace 2.00 long, 1.50 wide. Abdomen 2.50 long, 1.75 wide. Eye sizes and interdistances: AME 0.04, ALE 0.11, PME 0.13, PLE 0.15; AME-AME 0.03, AME-ALE 0.09, PME-PME 0.03, PME-PLE 0.02. Leg measurements: I: 5.15 (1.50, 1.75, 1.15, 0.75); II: 4.50 (1.35, 1.50, 0.95, 0.70); III: 4.05 (1.25, 1.30, 0.90, 0.60); IV: 5.85 (1.75, 1.85, 1.50, 0.75). Carapace yellowish; sternum flavescent. Abdomen beige, with black and wavy stripes, nearly egg-shaped. Legs yellowish, with black annulations. Epigyne: atrium small, almost square-shaped (width=length); receptacles oval, separated by less than 1/2 of their width, about 1.2 times as long as wide; copulatory ducts folded, with two parts, one membranous and another heavily sclerotized cylindrical, almost covered by receptacles; copulatory openings indistinct (Fig. 6A–B).

Distribution. Known only from the type localities (Fig. 7).

Acknowledgement

The manuscript benefited greatly from comments by Yuri M. Marusik (IBPN, Magadan, Russia), Mikhail Omelko (Far Eastern Federal University, Vladivostok, Russia) and Mykola Kovblyuk (V.I. Vernadsky Crimean Federal University, Simferopol, Crimea). English of the final draft was kindly checked by Victor Fet (Marshall University, West Virginia, Huntington, USA). This study was supported by the National Natural Sciences Foundation of China to Guo Zheng (NSFC-31172121, 31372224) and Shuqiang Li (NSFC-31272280, 31471960, 31530067). Part of the laboratory work was supported by Eco-Environmental Research Center Foundation of Shenyang Normal University (EERC-T-201502), Liaoning Excellent Talents in University (LJQ2012094).

References

- Chen L, Li S, Zhao Z (2015) Five new *Platocoelotes* species (Araneae, Agelenidae) from caves in southern China. *ZooKeys* 512: 1–18. doi: 10.3897/zookeys.512.9989
- Dankittipakul P, Chami-Kranon T, Wang XP (2005) New and poorly known species of coelotine spiders (Araneae, Amaurobiidae) from Thailand. *Zootaxa* 970: 1–11.
- Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R (1994) DNA primers for amplification of mitochondrial cytochrome oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3(5): 294–299.
- Han GX, Zhang F, Zhang ZS (2011) First description of the male of *Notiocoelotes pseudolingulatus* (Araneae: Agelenidae) from Hainan Island, China. *Zootaxa* 2819: 65–67.

- Liu J, Li S, Pham DS (2010) The coelotine spiders from three national parks in northern Vietnam. *Zootaxa* 2377: 1–93.
- Liu J, Li S (2010) The *Notiocoelotes* spiders (Araneae: Agelenidae) from Hainan Island, China. *Zootaxa* 2561: 30–48.
- Miller JA, Carmichael A, Ramirez MJ, Spagna JC, Haddad CR, Řezáč M, Johannesen J, Král J, Wang XP, Griswold CE (2010) Phylogeny of entelegyne spiders: affinities of the family Penestomidae (new rank), generic phylogeny of Eresidae, and asymmetric rates of change in spinning organ evolution (Araneae, Araneoidea, Entelegynae). *Molecular Phylogenetics and Evolution* 55: 786–804. doi: 10.1016/j.ympev.2010.02.021
- Wang XP (2002) A generic-level revision of the spider subfamily Coelotinae (Araneae, Amaurobiidae). *Bulletin of the American Museum of Natural History* 269: 1–150. doi: 10.1206/0003-0090(2002)269<0001:AGLROT>2.0.CO;2
- Wang XP, Xu X, Li S (2008) *Notiocoelotes*, a new genus of the spider subfamily Coelotinae from Southeast Asia (Araneae, Amaurobiidae). *Zootaxa* 1853: 1–17.
- Zhao Z, Su TJ, Chesters D, Wang SD, Ho SYW, Zhu CD, Chen XL, Zhang CT (2013) The mitochondrial genome of *Elodia flavipalpis* Aldrich (Diptera: Tachinidae) and the evolutionary timescale of tachinid flies. *PLoS ONE* 8: e61814. doi: 10.1371/journal.pone.0061814
- Zhu CD, Wang JF (1994) Seven new species of the genus *Coelotes* from China (Araneae: Agelenidae). *Acta Zootaxonomica Sinica* 19: 37–45.
- World Spider Catalog (2016) World Spider Catalog. Natural History Museum Bern. <http://wsc.nmbe.ch> [version 17.0 accessed on March 16, 2016]

